

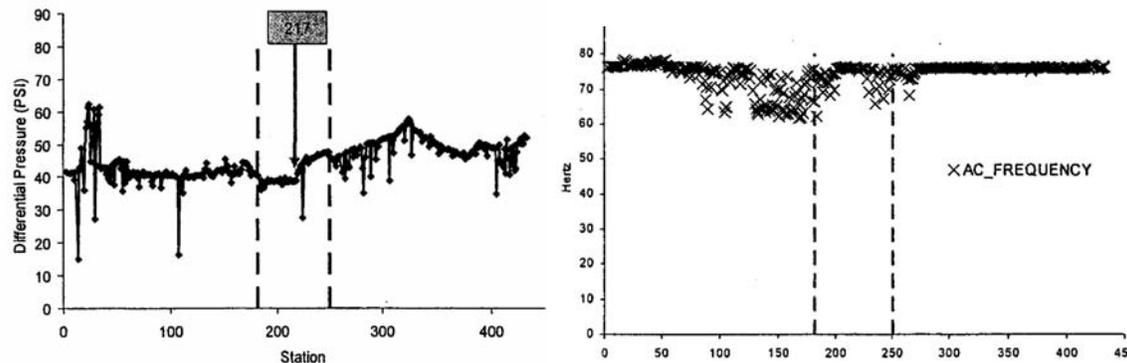
OCEAN QUAHOG APPENDICES

APPENDIX A1. Survey sensor package data from the 2005 NEFSC clam survey. Differential pressure and other data were analyzed to determine if the pump on the survey dredge performed as expected.

R/V Delaware II Clam Dredge Pump Performance⁷

Introduction

From an initial review of the Survey Sensor Pack (SSP) data, the dredge pump manifold differential pressure showed a significant variation over the course of the survey's three cruise legs (See Figure 1). This variation was sporadic during the first survey leg with the pressure spikes being attributed to blocked manifold nozzles from visual inspections at the dredge's retrieval. This however, can not explain the consistent upward trend in the manifold differential pressure starting in the middle of the 2nd survey cruise leg which continued to the middle of the 3rd leg with a then subsequent small falling trend towards the end of the survey. The numerous and sporadic pressure drop spikes that were also noted were not readily explainable by any events that occurred during the survey cruise.



Appendix A1. Figure 1 - SSP Manifold Differential Pressure Figure 2 - AC Pump Frequency

It was also noted that the frequency recorded also showed a large variation during the ends of the 1st and 2nd survey legs and was consistently higher than the 60 hertz that should have been expected (See Figure 2).

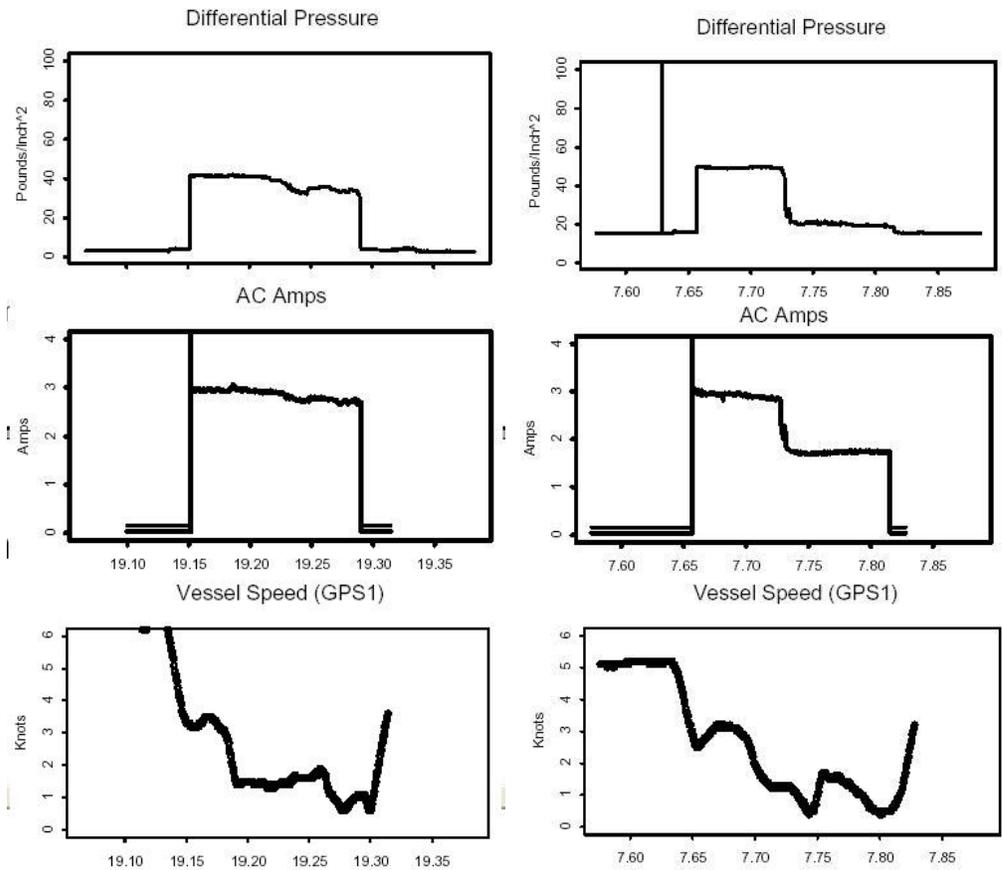
An overheated wire connection on the clam survey package's main breaker was discovered during station 217's tow and temporarily repaired for the remainder of the 2nd survey leg. The clam survey package's main breaker was replaced at the completion of the 2nd survey leg.

To first investigate these anomalies, a visual inspection of the clam survey sensor data plots for all of the survey tows was done. In particular the Y-Tilt (dredge angle), Manifold Differential Pressure, Pump AC Amps/Volts/Frequency, and Vessel Speed were reviewed. Each tow was graded in an Excel worksheet to summarize the basic characteristics as noted below.

⁷ Prepared by John Womack, Wallace and Associates, Ltd.

- Good/Bad Tow or Missing Sensor Data
- Approximate Manifold Differential Pressure
- Manifold Clogging or Pump Intake Blockage
- Erratic Dredge Angle (Y-Tilt); Front Middle, and End of Tow
- Dredge Pump Frequency; Front Middle, and End of Tow
- Tow Speed; Front Middle, and End of Tow
- Did a Low Speed Spike Occur (Tow speed < 1/2 knot)?

The first discovery is the explanation the sporadic pressure drop spikes in the manifold differential pressure. These pressure drop spikes are likely being caused by a temporary blockage of the pumps intake or the pump ingesting the discharge from the dredge manifold which somehow disrupts the pump's intake flow.



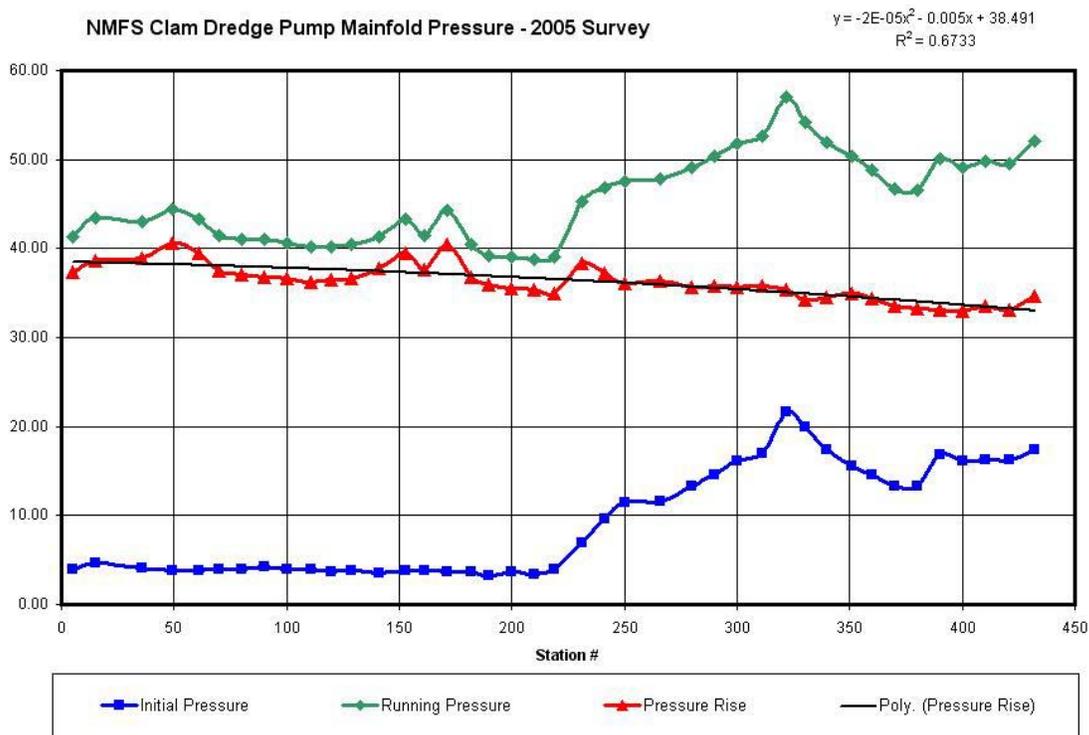
Appendix A1. Figure 3 - Station #71 Tow

Figure 4 - Station #405 Tow

Figure 3 shows a typical tow where this pump intake blockage has likely occurred. Note that there is a corresponding drop in the dredge pump's amps draw as the manifold pressure drops. This is typical for a centrifugal style pump such as is on the clam dredge. The drop in pressure could be minor as in Figure 3 or very substantial as shown in Figure 4. Figure 4 is likely an example of the pump ingesting the manifold discharge as it occurred when a very low speed spike, less than 1/2 knots, also occurred.

The visual inspection of the sensor plots also revealed the likely cause for the variation in the general trend of the pump manifold pressure. Using Figures 3 and 4, note that the differential pressures recorded before the pump was started were significantly different. For Figure 3 the starting value is about 5 PSI and for Figure 4 the value is about 15 PSI, a significant difference. Based on this, the following sensor values were graphed on a 10 station interval (those stations with obvious problems were ignored and the next nearest good station was selected, see Figure 5).

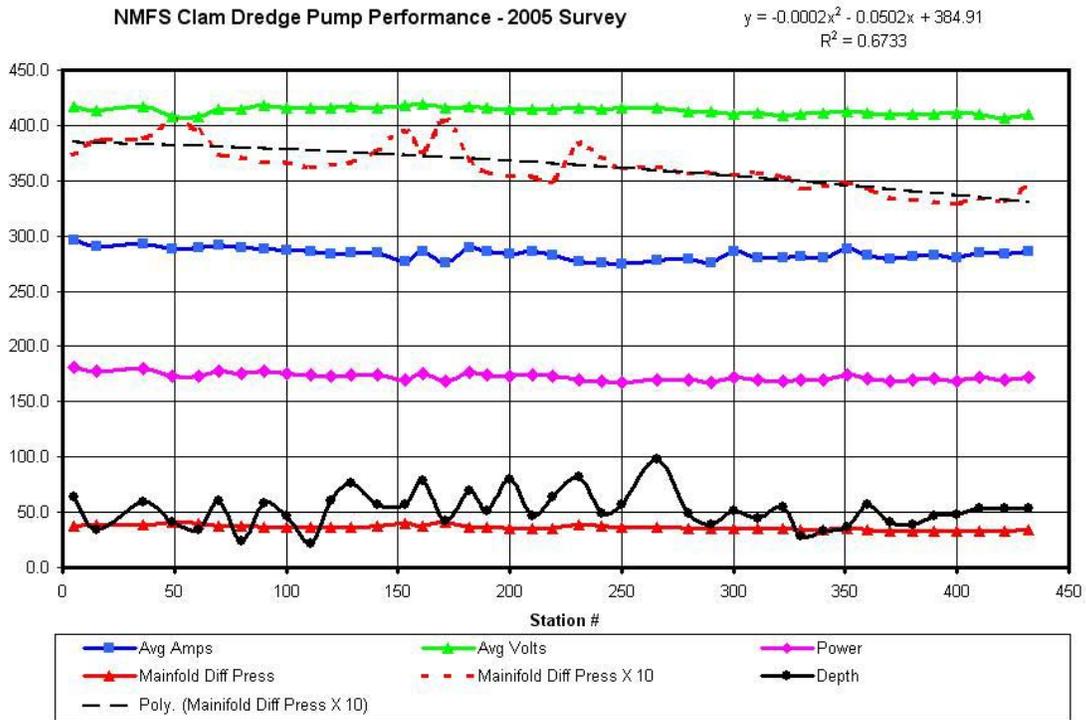
Manifold Differential Pressure Before Starting the Dredge Pump.
 Manifold Differential Pressure After Starting the Dredge Pump.
 Difference Between the After and Before Starting Values (Pump Pressure Rise)



Appendix A1. Figure 5

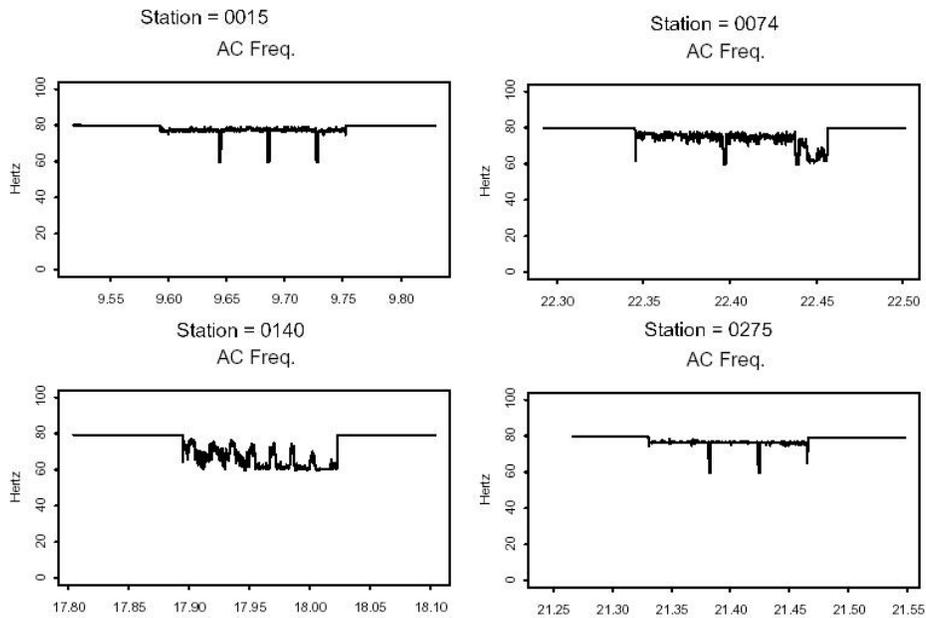
From Figure 5 the pressure rise in the dredge pump manifold is fairly steady with a consistent downward trend that is typical of a centrifugal pump becoming worn from sand/silt ingestion over the survey. The spikes at stations 49, 153, 171, and 231 are likely due to minor clogging of the manifold nozzles as there is a corresponding drop in the amps draw from the pump. This is shown in Figure 6 which also graphs the amps draw, AC voltage, pump power, and tow depth.

Based on this the conclusion is the general performance of the clam dredge pump was fairly uniform over the entire survey and the previous noted variations in the manifold differential pressure are likely due to a calibration drift in the SSP sensor. Interestingly this drift starts to occur at about station 217, which is when the problem with the main clam package breaker was noticed and repaired. How the breaker problem could cause a sensor drift is not known as the SSP package uses an internal DC battery completely separate from the AC system containing the clam package breaker.



Appendix A1. Figure 6

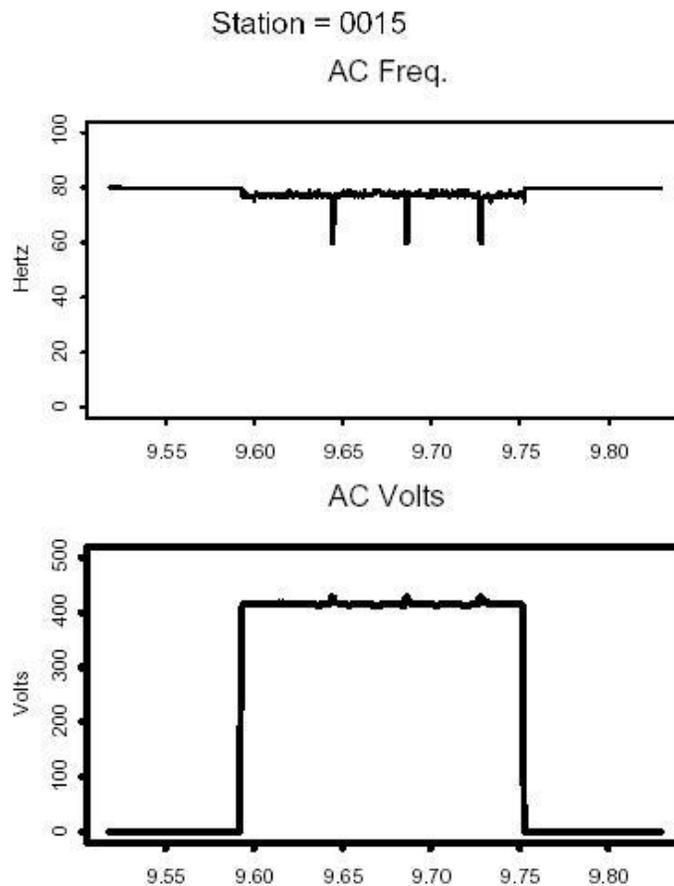
The variation that occurred in the recorded frequency remains a mystery even after the review of the sensor plots and conversations with the ship's engineer. The value should be very steady and between 59 and 61 hertz which is the output from the ship's generator. Figure 7 shows the typical variation in frequency that occurred during the survey.



Appendix A1. Figure 7

The frequency was fairly steady at the start of the survey, and then started a gradual degradation during the last half of the survey's first leg. This degradation in recorded values was not consistent with wide variations between tows. Shortly after the start of the 3rd leg at about station 271, the problem appears to have cleared itself and the frequency was very steady for the remainder of the survey. While there is no direct explanation for this change, it does not appear to have had any effect on the performance of the clam dredge. The hertz values seen by the pump during the survey are likely have to been the steady standard 59 to 61 hertz values shown on the ship's main switchboard. The changes are likely a problem is in the calibration of the sensor for the frequency not being at 60 hertz and some type of sensor interference for the variations experienced.

The last observation from the sensor plots and data is the occurrence of a rhythmic spike in the AC frequency and volts sensor plots. This occurred throughout the entire survey and a typical example is shown in Figure 8. As with the frequency variation discussed above this appears to be a sensor problem. First it is impossible for a generator to vary its speed as would be shown in the frequency plot. In addition there is no corresponding spikes in the amps or pump pressure that should occur if the volts were truly spiking.



Appendix A1. Figure 8